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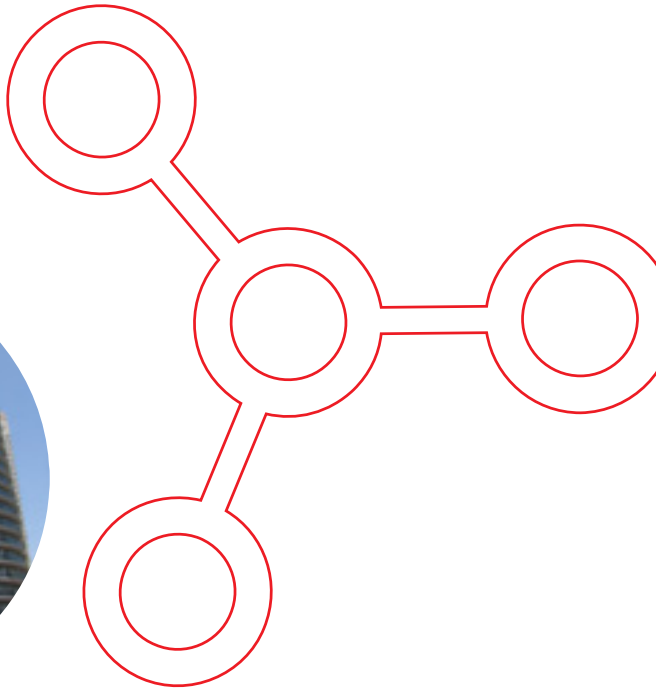
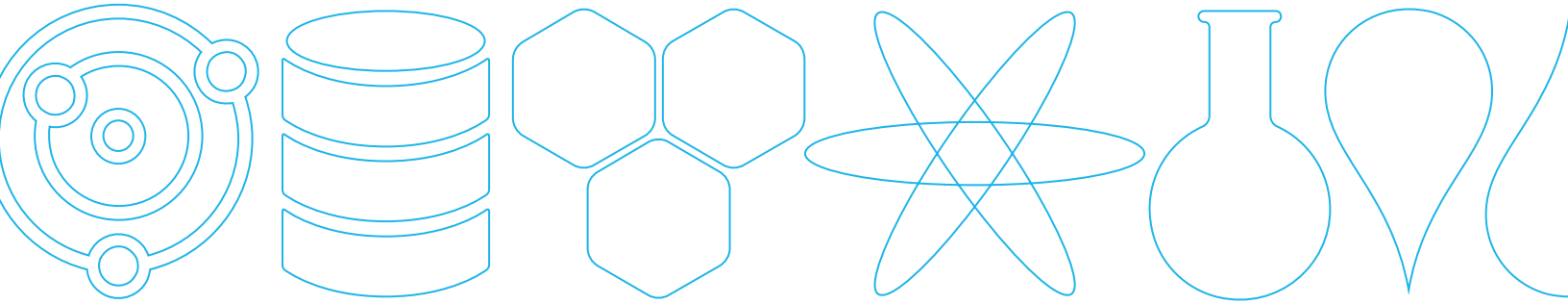




Paint Versus Anodized Coatings: Making the Right Application Choice for Aluminum Extrusion Building Products

Technical Paper

Aesthetics, coloration, durability and cost all play a role in the decision-making process when selecting the right finish for aluminum extrusion building products used in projects ranging from high-end residential to large commercial buildings. This paper provides an overview of what building owners and architects can expect from anodized versus painted aluminum to ensure they are making the best decision for their specific application needs.

Use of Aluminum Extrusion Building Products

Aluminum extrusion products are common in the construction of many building types from high-end residential homes to light commercial, high-rises, retail stores, sports stadiums, large commercial, schools and government buildings. Types of aluminum extrusion products can include entry canopies, storefronts, column covers, louvers and grills, curtain walls, window trim, wall panels. Aluminum products can be anodized or painted, providing different performance features and aesthetics.

Traditionally, high-end paints are more typically used on aluminum parts for high-end residential, light commercial and industrial buildings, storefronts, entry systems, windows, handrails and other high-traffic areas where surfaces come into contact with people. Anodized aluminum is more typically found on mid-range storefronts and institutional buildings such as schools and government buildings.

Architects are trending toward paint to create a signature look. Painted aluminum provides a way to differentiate architecture with a wide range of color options. Paint allows architects to match or complement glass, marble and stone features that have unique color ranges.
And paint keeps a building looking nice over time, especially in high traffic areas where painted aluminum can be recoated quickly and cost effectively to keep it looking fresh and crisp.

Economics also play a factor. If initial cost alone is the key driver, anodizing will often be selected because it has a lower initial cost. But, replacement costs are high if there is damage in the field because there is no simple way to repair or replace.

LIQUID AND POWDER PAINT COATINGS

STRENGTHS

- Exceptional mar resistance
- High-intensity color with vast array of color choices including naturals, mica and metallic
- Excellent color retention and UV resistance
- Outstanding protection against the elements, such as salt spray and humidity
- Abrasion and chemical resistance
- Powder-based coatings have no-VOCs
- High gloss levels for high traffic areas in 30° to 85°
- Protection of structural integrity
- Field touch-up/repair capabilities
- Small batch and custom-color capabilities (fast and cost effective)
- Some ability to form the finished product

LIMITATIONS

- Coating is mar resistant but can be scratched
- Potential for inconsistent appearance of metallic paints
- Solvent-based paints require addition of oxidizer to make environmentally-friendly

ANODIZED COATINGS

STRENGTHS

- Color stability if pigments are used (if color dyes are used, colors can fade)
- Hardness as compared to a sapphire
- Durability and abrasion resistance
- Protection of structural integrity
- Corrosion protection

LIMITATIONS

- Limited color choices
- Color variation batch to batch (lower industry requirements than paint)
- Matt finish unless can be polished for some gloss (higher cost)
- Inability to touch-up scratches or mars
- Surface imperfections of aluminum can be seen
- Limited ability to form finished product because (will crack or craze)
- Spider-web cracking on gloss anodized surfaces can occur (caused by thermal shock, humidity, film thickness)
- Numerous chemicals used in anodizing process
- Aluminum alloy composition strongly influences anodizing color and corrosion performance

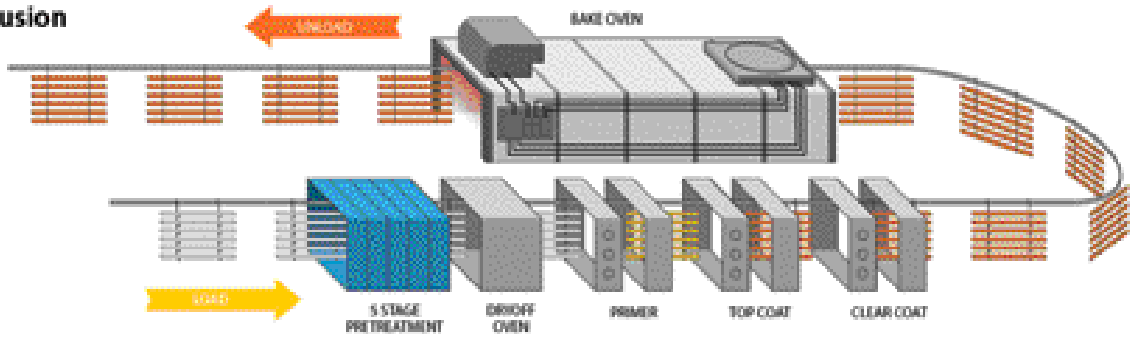
Coating Processes: Painting Versus Anodizing

The coating processes differ markedly between spray-applied paint and anodizing.

TYPICAL PAINTING PROCESS

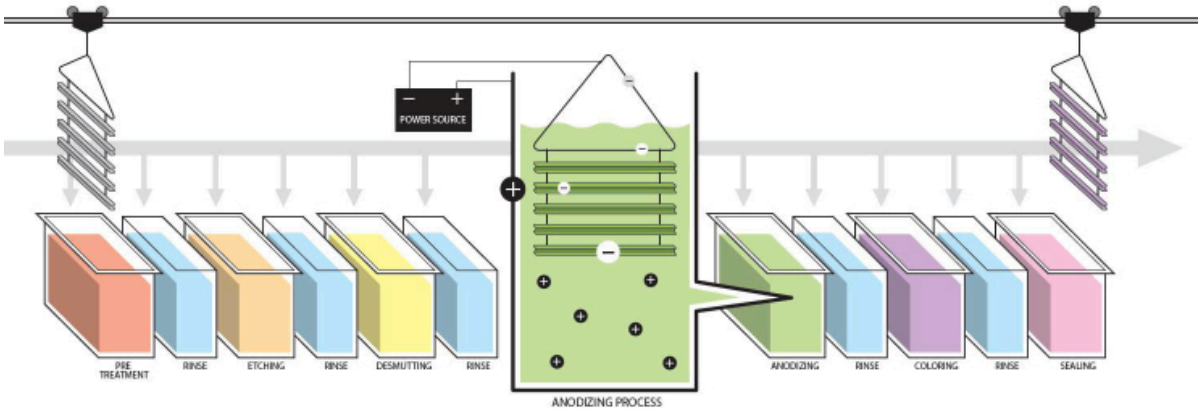
The process for painting aluminum is similar to the process for painting other surfaces. A series of cleaning/pre-treatment steps are used to prepare the metal. Then, either a liquid or powder coating is applied and color matching is precise from batch to batch, and the coating film hides any metal surface defect. Toll coaters and applicators can typically provide output at the rate of 15-feet-per-minute on a liquid vertical line. Powder coating lines operate at 5- to 7-feet-per-minute.

Horizontal Extrusion Coating Line



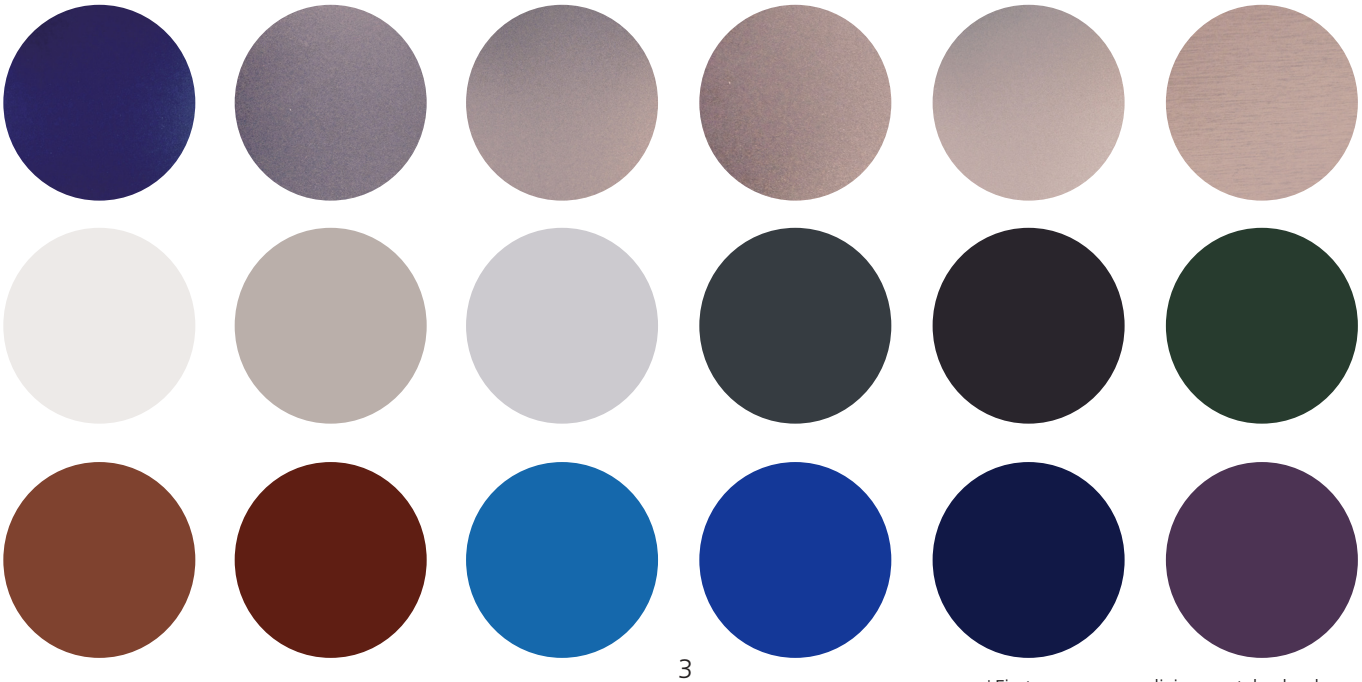
TYPICAL ANODIZING PROCESS

Anodizing is an electrochemical process that is fully integrated with the underlying aluminum substrate, so it cannot chip or peel unlike paint or plating which is applied to the surface. The process for anodizing aluminum has more steps than painting. Because the color absorbs into the aluminum substrate versus the surface being painted, there is more color variation from batch to batch, making color matching challenging and no ability to cover surface defects. Toll coaters and applicators can typically provide output at half the rate of painting aluminum. Electrical energy consumption is far higher than in the coating process.



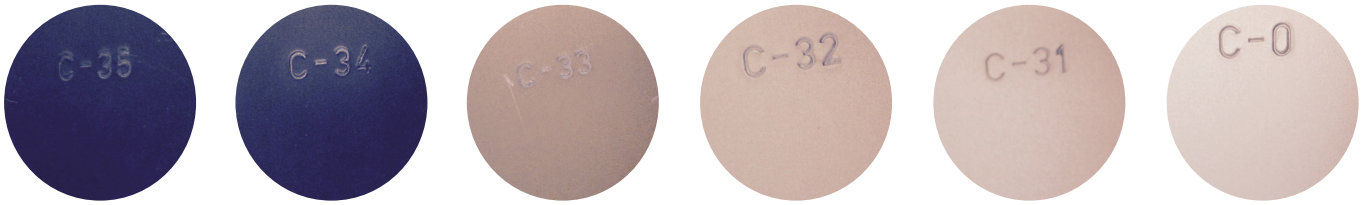
Color Options and Finish Hardness

Painted aluminum has a clear advantage from a color point of view. The color options are almost limitless and special finishes are available including high-intensity color, naturals and metallic. Color consistency is maintainable batch-to-batch with paint, making it a clear choice for ensuring different components of a building deliver the desired end look. It is easier to match various elements of paint on the building components as well—even between painting systems, such as spray versus coil. The industry-standard paint finish range is narrower than anodizing at 2 Delta E, allowing better color matching. Since paint color is three-dimensional, it can appear a different hue depending on the space it is being used in and how much light and what type of light is in the space. Coatings also are better at hiding defects in the substrate than anodizing, which shows all defects. Painted coating finishes are rugged, but can be scratched if handled roughly in the field, although hiqh-quality touch up is simple.



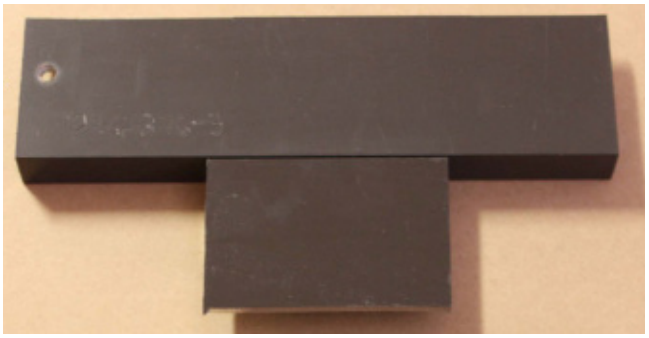
*First row are anodizing matched colors.
*Only a small sampling of available colors.

Anodizing is available in a limited color selection in the following categories: clear, champagne, bronze, gold/silver, black, blues, greens and reds depending on the coater. Specialty colors can be selected, but this can substantially increase the cost. Anodizing achieves a true metallic look in the finish, which is translucent to transparent. Since it is harder to control color with anodizing, there is more variability from batch to batch. The anodized standard industry finish range is 2-3 Delta E, assuming the metal alloy is always the same. Multiple alloys will create slightly different hues as the anodize responds to the alloys. This can cause a problem, particularly on major projects where different batches of anodized aluminum are delivered over a period of months or years. Anodizing provides a very hard coating that is not easily marred.

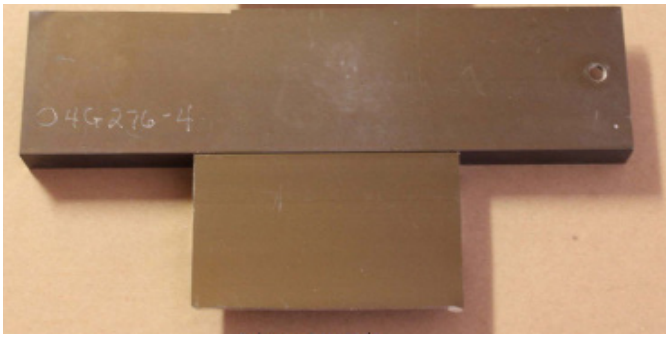


Weatherability and Field Repair

Both anodized and painted finishes are durable provided that high-quality processes and products are used in the production process. Painted surfaces tend to be more resistant to corrosion, acid rain and mortar staining. And, painted surfaces can be restored quickly and easily in the field, especially in high traffic areas. The finish on anodized aluminum provides resistance to corrosion and acid rain, but can be destroyed if the masonry mortar is not removed immediately. Replacement is the only remedy. Painted finishes have detailed industry tests and standards for performance; whereas anodizing has not adopted standard tests.



Color: Bronze, Liquid Paint 70% PVDF over Aluminum



Color: Bronze, Anodize with Aluminum

Panel	Top Coat	Color	% Gloss Retention, ASTM D523	Color Measurement, Delta DE, ASTM D 2247
04G276-3	70% PVDF	Bronze	64%	-0.61
04G276-4	Anodize	Bronze	75%	-2.39

Initial Pricing Versus Life Cycle Costs

Typically powder coatings are the least expensive options because parts can be coated in a one-coat process. For the standard few colors anodizing is available in, it can be lower cost than liquid paint. However, if a color is requested in anodizing, paint becomes a less-expensive process.

Great Britain originally established the gold standard for anodizing at 25 microns, and this high-quality anodizing process is the most costly. But, this standard has not been adopted globally and coaters typically provide a thinner anodized layer. This lowers the initial cost for anodizing but also reduces weathering and field performance of the anodized product.

For coatings, quality can vary greatly, so it is important to specify project requirements on the front-end for coating longevity, get several bids and understand the differences between coating options and suppliers to ensure the coating will last the expected number of years. Liquid and powder coatings vary in cost with powder typically less expensive than liquid or anodizing since it is a one-step coating process.

Paint has a clear advantage over a lifetime of use when field upkeep and repair is required. Touchup is easy and fast using high-quality paint, especially in high traffic areas, such as a commercial building where people are going in and out of doors or boxes or equipment that bump against walls and frames. High quality paints can be used so the aluminum has a factory-finish look and durability. With anodizing, the aluminum cannot be touched up. It needs to be replaced, which is expensive.

Warrany Considerations

Understanding warranty coverage is important when selecting a coil coater. Paint coating warranties can range from 0 to 40 years on gloss and color retention depending on the type of coating and location of the world. For example, warranties are more common in the U.S. than in continental Europe.

Anodizing warranties can range from five years to "lifetime" with various qualifications on what is covered, such as filiform corrosion. In the U.S., anodized coatings typically have a warranty that ranges from five years for a thinner coating to 10 years for a thicker anodized coating. In Europe, anodizers typically refer to QUALANOD European standards where anodizing for outdoor metal is recommended with a minimum of 15 microns thickness. For more information about warranties, please visit websites listed in Sourcing section at the end of this whitepaper. 2

Case Study: Willis Tower in Chicago

The Willis Tower, North America's tallest building soars majestically above the Chicago skyline in the heart of downtown. Home to hundreds of thriving businesses and host to 25,000 daily tourists, the breathtaking views of the city are awe-inspiring. Not only is Lake Michigan visible from the viewing deck, but also the states of Illinois, Indiana, Wisconsin and Michigan.

This global icon attracts people from all over the world, particularly the "Ledge," where visitors can step out from the building and see 1,354 feet straight down to the street from one of a series of enclosed glass cubicles.

Few people know, however, that the Willis Tower is protected by Valspar extrusion coatings.

When the building opened in 1973 as the Sears Tower, the exterior was black anodized aluminum. Over time, the building began to show its age. The anodized aluminum began to oxidize, and aluminum rust formed, which appeared as white spots over the entire tower. The building underwent a major renovation, and the entire exterior surface of the building was replaced with painted aluminum. Valspar was entrusted to provide a spectacular gleaming black finish that would stand the test of time for this iconic building exposed to sub-zero temperatures in the winter and heat and humidity in the summer months.

Willis Tower Fun Facts

- 1,450 feet high (443 meters); 1,750 feet high including the twin antennae
- 110 stories tall
- 4.5 million gross square feet (418,064 gross square meters) of floor space
- Would cover 105 acres if spread across one level or the equivalent of16 city blocks in Chicago.
- Weighs 222,500 tons
- Cost more than $175 million to build.
- 25 miles of plumbing, 15,000 miles of electric wiring and 80 miles of elevator cable
- 104 elevators moving 1,200 feet per minute

According to the Willis Tower website, "Only the finest materials are used throughout the buildings common areas to highlight the property's prestige, such as the lobby's walls of travertine highlighted with stainless steel trim, polished granite flooring and decorative ceiling lighting." Valspar is proud to play a major role in protecting this valuable, iconic asset through its extrusion coatings.

Conclusion:

Making the Choice between Anodized and Paint

As this paper illustrates, a number of factors need to be considered when choosing between anodized or painted aluminum extrusion to ensure customers select the coating most appropriate for the application. Architects and building owners should consider not only the aesthetics, unique features of the coating and initial cost, but field performance over time before making the choice that is right for their needs. Toll coaters and applicators along with coating manufacturers can provide more specific information to help in the decision-making process to ensure the right choice for the application.

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SOURCES:

Valspar Technical team and www.valsparcoilextrusion.com/en/index.html

1Aluminum Anodizing Council: www.anodizing.org

2Anodizing warranty example from United Anodisers:
http://unitedanodisers.com/index.php/the-ua-group/lifetime-guarantee.html

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